# Distribution Generation Grid Interconnection

Austin Distributed Energy Road Show

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# AUSTIN ENERGY SERVICE STATISTICS

- Service area size - 421 square miles
- Transmission line mileage
  - 345 kV lines ……180 miles
  - 138 kV and 69 kV lines ……327 miles
- Distribution line mileage
  - Overhead and Underground ….8,880 miles
- Substations ……60
- Customers Served ……364,311

# AUSTIN ENERGY SERVICE STATISTICS

- Generation Resources - 2,553 MW
  - 1,540 MW capacity from natural gas/oil units
  - 400 MW capacity from South Texas Nuclear units
  - 600 MW capacity from Fayette coal units
  - 13 MW capacity from renewable resources
- System Peak - 2,383 MW

# Distributed Energy Resources

- Not a new concept
  - Power Plants are distributed
- Has been around for decades
  - Industrial cogeneration
  - Large power users
- What is new is size, technology, location

# DG mode of operation

- Emergency

  - Emergency systems, Legally required
- Isolated

  - Disconnected from grid with the grid energized

# DG mode of operation

- Base Loaded
  - Connected to grid with power output
  - Cogeneration system
- Peak Shaving
  - Connected to grid
  - Variable power output

# DG Technologies

- Steam Turbines
- Reciprocating Engine
- Combustion Turbines
- Microturbines
- Fuel Cells
- Photovoltaic
- Wind Turbines

# DG Interconnection Issues

- Safety – Interruption of the utility supply may not de-energize a circuit
- Equipment Protection – All equipment should be protected from abnormal voltage and frequency excursions
- Fault Detection – All faults need to be detected and interrupted

# DG Interconnection Issues

- Service Restoration – Automatic reclosing to restore service may damage DG
- Quality of Service – Sustained overvoltage, undervoltage and flicker should be avoided

# DG Interconnection Standards

- AE Standard Interconnection Guidelines
- Public Utility Commission of Texas, Distributed Generation Interconnection Manual
- IEEE P1547, P1589, P1608, P1614 Draft Standards for Interconnecting Distributed Resources with Electric Power Systems

# INTERCONNECTION REQUIREMENTS

1. Manual Disconnect

   - Facilitate maintenance of utility's electrical system

   - To disconnect generation during emergency conditions

   - To disconnect if customer's generation is operating in unsafe manner

   - If customer's generation adversely affecting utility's customers

# INTERCONNECTION REQUIREMENTS

2. Protective Relaying

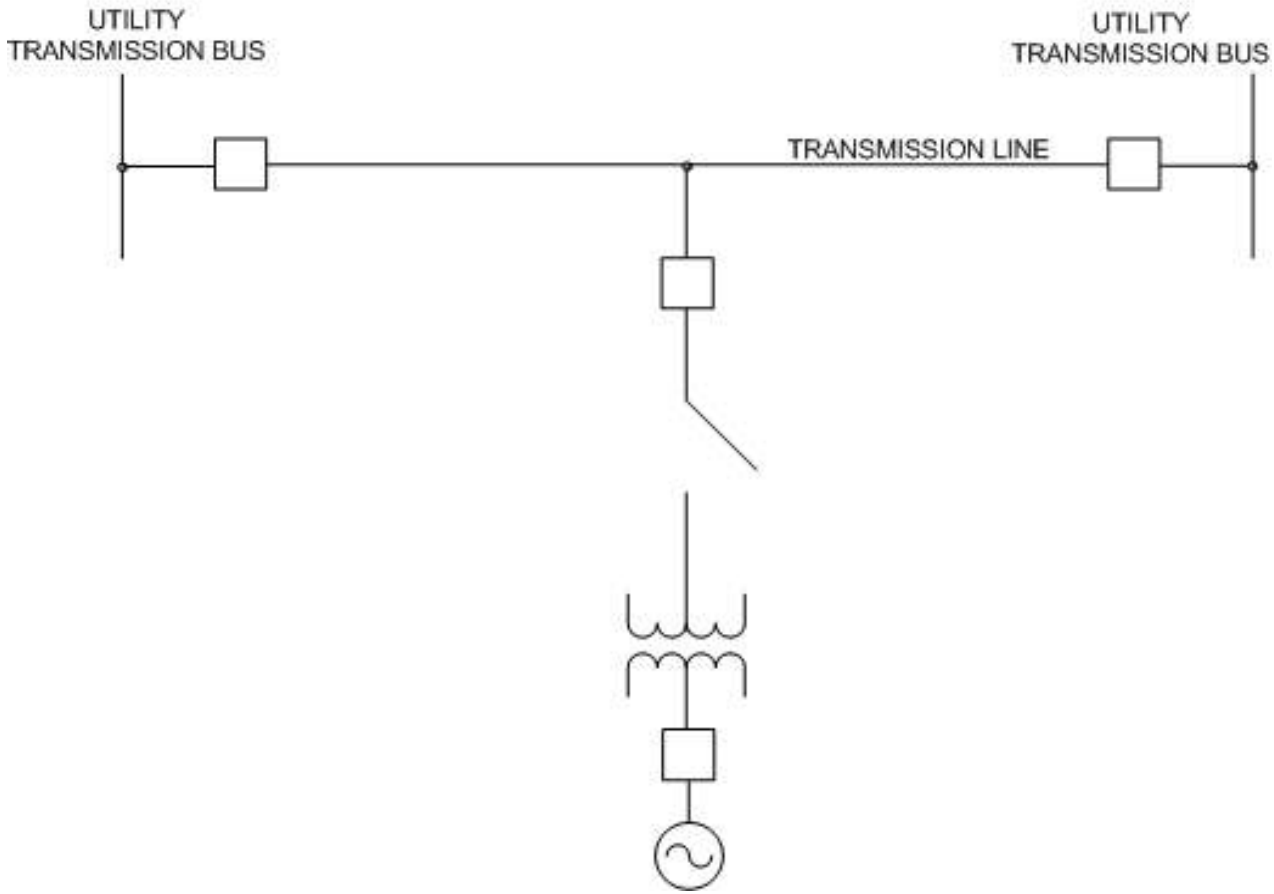
The customer shall provide protective relaying to automatically disconnect the customer's generation from the grid in the event of a fault or loss of source

## Table 3-2: DG Interconnection Requirements

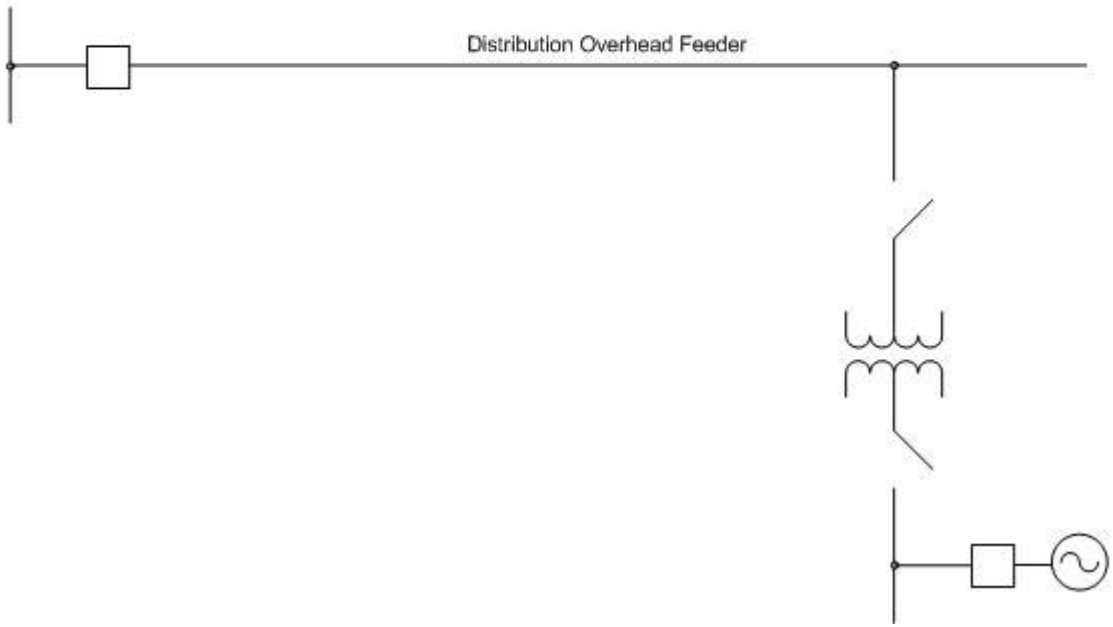
| | Closed Trans-ition | Single-Phase | Three-Phase | | | |
|---|---|---|---|---|---|---|
| | Capacity | | | | | |
| **Feature** | ≤10 MW | ≤50 kW | ≤10 kW | 10 kW - 500 kW | 500 kW - 2 MW | 2 MW - 10 MW |
| PUCT Rule Reference | §25.212-(g) | §25.212(d) | §25.212(e)-(3)(A) | §25.212(e)(3)-(B) | §25.212(e)-(3)(C) | §25.212-(e)(3)(D) |
| Interrupting devices (capable of interrupting maximum available fault current) | ✓ | ✓ | ✓ | ✓ | ✓ | [4] |
| Interconnection disconnect device (manual, lockable, visible, accessible) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Generator disconnect device | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Over-voltage trip | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Under-voltage trip | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Over/Under frequency trip | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Synchronizing check (A: Automatic, M: Manual) | A | A/M [1] | A/M [1] | A/M [1] | A [1] | A [1] |
| Ground over-voltage or over-current trip | [2] | | | [2] | [2] | [2] |
| Reverse power sensing | | | | [3] | [3] | [3] |
| If exporting, power direction function may be used to block or delay under frequency trip | | | | | ✓ | ✓ |
| Automatic voltage regulator | | | | | | [1] |
| Telemetry/transfer trip | | | | | | ✓ |

Notes:
✓ – Required feature (blank = not required)
[1] – Required for facilities with stand-alone capability
[2] – May be required by TDU; selection based on grounding system
[3] – Required, unless generator is less than applicant minimum load, to verify non-export
[4] – Systems exporting shall have either redundant or listed devices

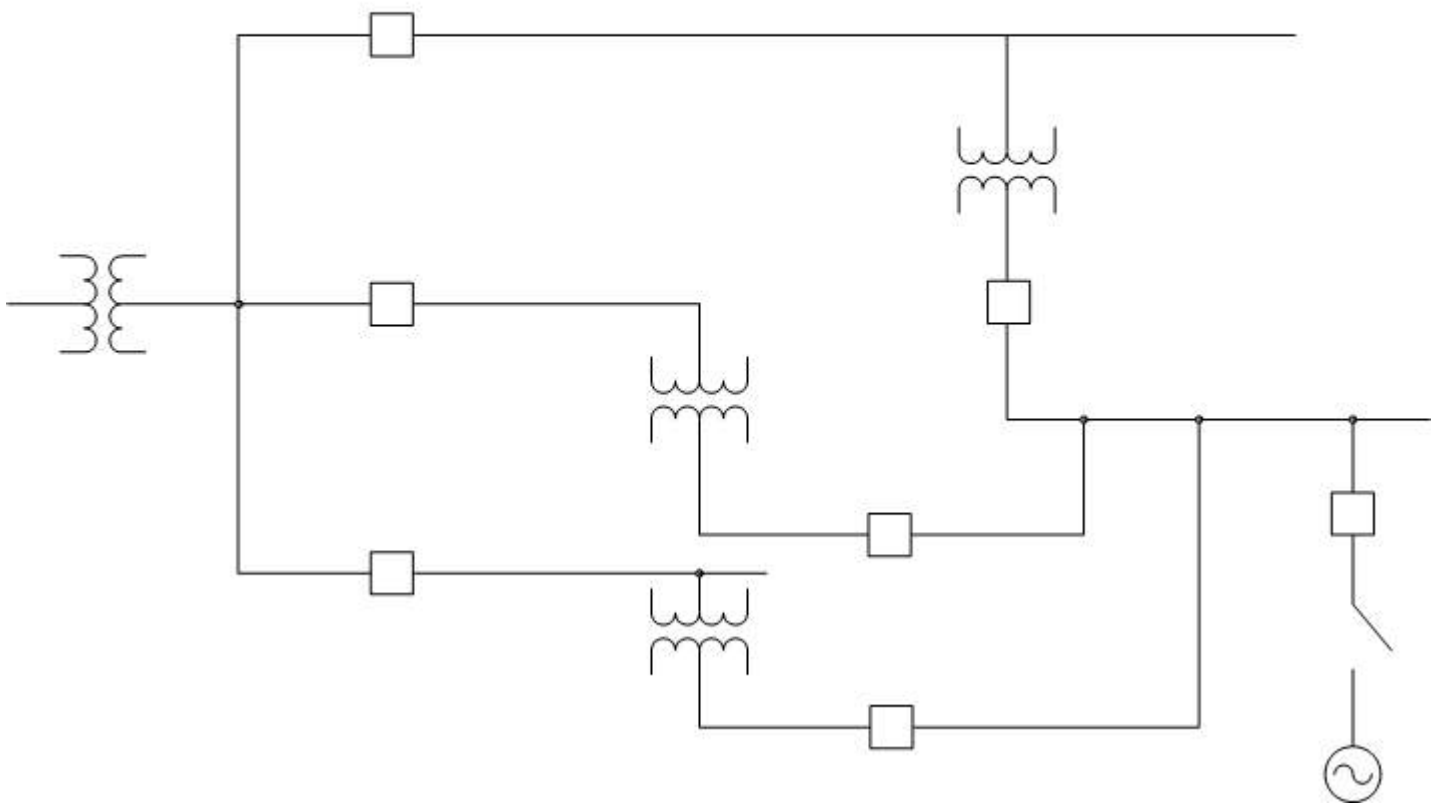
# D.G. CONNECTED TO UTILITY TRANSMISSION LINE



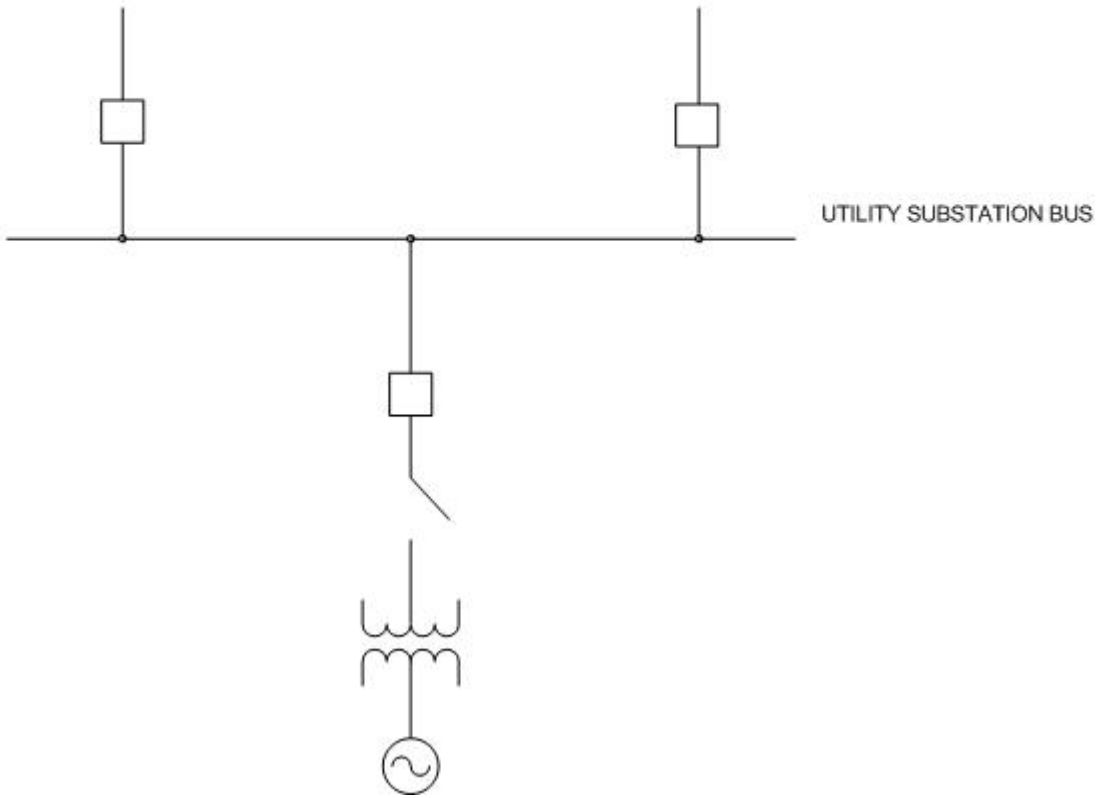
# D.G. CONNECTED TO UTILITY OVERHEAD DISTRIBUTION SYSTEM



# D.G. CONNECTED TO UTILITY UNDERGROUND NETWORK SYSTEM



# D.G. CONNECTED TO UTILITY SUBSTATION BUS



# DG Interconnection Summary

- DG not a new concept
- DG in different operating modes
- Multiple technologies, different application
- Interconnection issues
- Available standards
- Different possible interconnections